PCT WELTORGANISATION FÜR GEISTIGES EIGENTUM Internationales Büro INTERNATIONALE ANMELDUNG VERÖFFENTLICHT NACH DEM VERTRAG ÜBER DIE INTERNATIONALE ZUSAMMENARBEIT AUF DEM GEBIET DES PATENTWESENS (PCT)

(51) Internationale Patentklassifikation 7:

H04L 27/26, 25/03

(11) Internationale Veröffentlichungsnummer:

WO 00/60822

(43) Internationales

Veröffentlichungsdatum:

12. Oktober 2000 (12.10.00)

(21) Internationales Aktenzeichen:

PCT/DE00/00699

A1

(22) Internationales Anmeldedatum:

6. März 2000 (06.03.00)

(30) Prioritätsdaten:

199 14 797.3

. 31. März 1999 (31.03.99)

DE

(71) Anmelder (für alle Bestimmungsstaaten ausser US): SIEMENS AKTIENGESELLSCHAFT [DE/DE]; Wittelsbacherplatz 2, D-80333 München (DE).

(72) Erfinder; und

(75) Erfinder/Anmelder (nur für US): ZIRWAS, Wolfgang [DE/DE]; Mittenwalder Strasse 136, D-82194 Gröbenzell

(74) Gemeinsamer Vertreter: SIEMENS AKTIENGE-SELLSCHAFT; Postfach 22 16 34, D-80506 München (81) Bestimmungsstaaten: CN, JP, US, europäisches Patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE).

Veröffentlicht

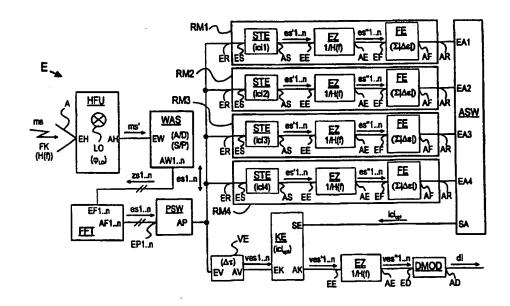
Mit internationalem Recherchenbericht. Vor Ablauf der für Änderungen der Ansprüche zugelassenen Frist; Veröffentlichung wird wiederholt falls Änderungen eintreffen.

(54) Title: METHOD, USE OF SAID METHOD AND RECEIVER SYSTEM FOR RECEIVING MULTI-CARRIER SIGNALS PRESENTING SEVERAL FREQUENCY-DISCRETE SUBCARRIERS

(54) Bezeichnung: VERFAHREN, VERWENDUNG DES VERFAHRENS UND EMPFANGSANORDNUNG ZUM EMPFANG VON MEHRERE FREQUENZDISKRETE SUBTRÄGER AUFWEISENDEN MULTTTRÄGERSIGNALEN

(57) Abstract

received ln multi-carrier signal (ms) which presents subcarrier-specific interference (ici0) caused adjacent subcarriers by (stl...n) said subcarriers additionally (st1...n) are subjected to interference in a targeted manner and a correction information represents (iciopt) which subcarrier-specific the interference (ici0) is derived from the subcarriers The received (stl...n). subcarriers (st1...n) are then corrected by means of the correction information. Low-cost oscillators can advantageously be used economical to produce transmitter and receiver units.



Patent Claims

A method for receiving a multicarrier signal (ms) having a number of frequency-discrete subcarriers (stl...n) and into which information is inserted 5 which is converted by means of a multicarrier method to frequency-discrete modulation-specific modulation symbols with the individual frequencydiscrete subcarriers (stl...n) of the multicarrier signal (ms) transmitted via a transmission medium 10 (FK) each being subject to subcarrier-specific by subcarriers caused disturbances (ici0) (stl...n) arranged adjacent in the frequency domain,

15 characterized

35

- in that the subcarriers (stl...n) of the received multicarrier signal (ms) are additionally deliberately subjected to disturbances,
- on that correction information (ici opt) which represents the subcarrier-specific disturbances (ici0) is derived from the subcarriers (stl...n) which have been additionally deliberately subjected to disturbances, and
- 25 in that the subcarriers (stl...n) of the received multicarrier signal (ms) are corrected in accordance with the determined correction information (ici_{opt}).
- 30 2. The method as claimed in claim 1, characterized

in that a number of different test disturbances (icix) are provided, with the subcarriers (st1...n) being deliberately subjected to disturbances, in the event of a test disturbance

(icix), by means of constant or frequency-dependent disturbance information (icil...4).

- The method as claimed in claim 2, characterized
 - in that the received symbols (esl...n) which represent frequency-discrete subcarriers (stl...n) are derived from the received multicarrier signal (ms),
- or in that k differently defined reference disturbance information items (icil...4) are provided, in which case, for each reference disturbance information item (icil...4),

	(a)	the received symbols (esln) in the
	(-,	subcarriers (st _{i-1} , st _{i-1}) which are in
		each case arranged adjacent around at
		least some of the subcarriers (st;) in
5		the frequency domain are each subjected
		to disturbances from the reference
		disturbance information (icil4), and
		the disturbed received symbols in the
		adjacent subcarriers (st _{i-1} , st _{i-1}) are
10		then additively superimposed as
		deliberate test disturbances (icix.,
		icix,) on the received symbol (es1n)
•		in the additionally disturbed subcarrier
		(st _i),
15	- (b)	in that the additionally deliberately
		disturbed received symbols (es'1n)
		are each compared with the closest
		modulation-specific modulation symbol, and subcarrier-specific error
		information (Δε1n) is formed as a
20		
		function of the comparison results, and disturbance-information-specific sum
	(c)	error information (selk) is formed
		from the subcarrier-specific error
25		information (Asln), and
25	- (đ)	in that the correction information
	- (4)	(iciont) is derived from the k reference
		disturbance information items (ici1k)
		and the k sum error information items
30		(stlk).
30		·

The method as claimed in claim 3, characterized

- in that the frequency-discrete received symbols

(esl...n) derived from the received multicarrier signal (ms) are delayed or are

temporarily stored until the correction information (icion) has been established,

- (e) in that the delayed received symbols (vesl...n) in the subcarriers (st_{i-1}, st_{i+1}) which are in each case arranged adjacent around a subcarrier (st_i) in the frequency domain are each corrected by the determined correction information (ici_{opt}), and are then additively superimposed on the delayed received symbol (vesl...n) in the subcarrier (st_i).

10

5. The method as claimed in claim 3 or 4, characterized

in that the k reference disturbance information items (icil...k) and the k disturbance-information-specific sum error information items (sel...k) derived from them are used to establish a correction function (KF) which is used to calculate the correction information (icicpt).

- 10 6. The method as claimed in claim 5, characterized
 - in that four defined reference disturbance information items (icil...4) are provided, and are used to derive the four disturbance-information-specific sum error information items (sel...4) and
 - in that the correction information (iciont) is calculated by

$$ici_{+} = \left(\frac{se4 - \frac{(se1 + se3)}{2}}{2(se1 - se3)}\right) - (ici1 - ici3) + \frac{ici4}{2}$$

20

15

25

where stl...4 represents the four sum error information items (stl...4), and icil...4 represents the four reference disturbance information items (icil...4).

 The method as claimed in claim 3 or 4, characterized

in that the correction information (ici pt) is determined in the course of an iterative search, with the k reference disturbance information items (ici1...4) being established in the course of the iterative search, and the steps (a) to (c) being

repeated until a minimum value of the disturbance-information-specific sum error information (ϵ_{\min}) is determined, and the correction information (ici_{opt}) has been derived from this.

 The method as claimed in one of claims 3 to 7, characterized

in that the additionally deliberately disturbed received symbols (es'l...n) are in each case corrected by equalization as a function of frequency-selective transmission characteristics (H(f)) of the transmission medium (FK) before the comparison with the respective closest modulation-specific modulation symbol.

10

15

. . 5

- The method as claimed in one of claims 3 to 8, characterized
 - in that, once steps (a) to (d) have each been carried out for each reference disturbance information item (icil...4)
- the received symbols (esl...n) of the -- (a') subcarriers (st_{i-b} , st_{i-b} , where b > 1) which are each arranged further away from at least some of the subcarriers (st_i) in the frequency domain are each 20 subjected to disturbances from the information disturbance reference (icil...4), and the disturbed received symbols are then additively superimposed as deliberate test disturbances (icix., 25 $icix_{*1}$) on the received symbol (esl...n) of the additionally disturbed subcarrier (st₁), and steps (b) to (d) are then carried out.

30

- The method as claimed in one of claims 2 to 9, characterized
- in that the received symbols (ves'l...n) which have been corrected using the correction information (icion) are demodulated,,

10

- in that errors are identified in the demodulated received symbols (di) using error identification information inserted into the transmitted information, and identified, erroneous received symbols (es'l...n, es''l...n) are corrected,

- in that, when errors are identified, steps (b) to (d) are carried out once again, with the corrected received symbols (es'l...n, es''l...n) being used for determining the correction information (iciont).

11. The method as claimed in one of the preceding claims,

characterized

- in that the multicarrier method is provided by means of an OFDM transmission method Orthogonal Frequency Division Multiplexing or by means of a transmission method based on discrete multiple tones DMT.
- 10 12. The method as claimed in one of the preceding claims,

characterized

in that the transmission medium is in the form of a wireless radio channel or a cable-based or wirebased transmission channel.

- 13. The method as claimed in claim 12,

 characterized

 in that the information is transmitted via power

 supply lines.
 - 14. Use of the method according to the invention as claimed in one of the preceding claims, characterized
- 25 in that the received multicarrier signal (ms) is demodulated,
 - in that errors contained in the demodulated multicarrier signal (di) are identified using an error handling routine and are corrected,
- orrectability of the errors.
- 35 15. A receiving arrangement for receiving a multicarrier signal (ms) having a number of

frequency-discrete subcarriers (stl...n) and into which information is inserted which is converted into frequency-discrete modulation symbols by means of a multicarrier method,

with the individual frequency-discrete subcarriers (stl...n) of the multicarrier signal (ms) transmitted via a transmission medium (FK) each being subject to subcarrier-specific disturbances (ici0)

10

caused by subcarriers (stl...n) arranged adjacent in the frequency domain,

characterized

- in that disturbance means (RM1..4) are provided for additional, deliberate disturbance of the received multicarrier signal (ms),
- in that means (ASW) are arranged for deriving (ici_{opt}), information correction represents the subcarrier-specific disturbances (ici0), from the additionally deliberately disturbed subcarriers (stl...n, es'l...n, es''1...n), and
- in that means (KE) are provided for correction of the frequency-discrete subcarriers (stl...n, vesl...n) as a function of the determined 15 correction information (ici opt).

Abstract

Method, use of the method and a receiving arrangement for receiving multicarrier signals having a number of frequency-discrete subcarriers

In a received multicarrier signal (ms) which is subject to subcarrier-specific disturbances (ici0) caused by adjacent subcarriers (stl...n), the subcarriers (stl...n) are additionally deliberately subjected to disturbances, and correction information (iciopt) which represents the carrier-specific disturbances (ici0) is derived from the subcarriers (stl...n) which have been additionally deliberately subjected to disturbances and is then used to correct the received subcarriers (stl...n). Low-cost oscillators can advantageously be used to provide cheap transmitting and receiving units.

FIG 2